Post Mortem Organ Weight at Bhayangkara Pekanbaru Polda Riau Hospital, Indonesia

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Abstract

Post mortem organ weight is one of indicator that serves as supporting evidence in determining the cause of death, because if there is a difference between the post mortem organ weight with normal organ weight indicates the occurrence of pathological conditions that may be related to the cause of death. The objective of this study was to determine post mortem organ weight in autopsy cases at Bhayangkara Pekanbaru Polda Riau Hospital in 2017-2018. This research is a retrospective descriptive study using secondary data. Data were obtained from autopsy data in the forensic section of Bhayangkara Pekanbaru Polda Riau Hospital in 2017-2018. Data were analyzed by using univariate analysis carried out on each variable of the research results. The results of this study were obtained from twenty one autopsy cases with a mean value of organ weight: the brain (1334.29 grams), liver (1130.90 grams), right lung (370.48 grams), left lung (311.24 grams) gram), heart (275.33 grams), left kidney (114.52 grams), right kidney (114.00 grams), and spleen (113.43 grams). Organs in men are heavier than women, except the liver. Organ weight has decreased in old age. People with short bodies tend to have lighter organ weights than people with tall bodies. The conclusion of this study is the average value of post mortem organ weight in this study is different from the weight value of organs found in forensic textbooks.

Keywords: *autopsy, post mortem, organ weight*

Introduction

Autopsy is one of the important parts in medical science, because in addition to establish the final diagnosis, the function of autopsy also to find the relationship between the cause of death with abnormalities in the organs that cause death, and can explain the relationship between these. An autopsy is done in suspicious death case, death due to murder, and sudden death without apparent cause.[1]

Autopsy consists of 2 types examination, external and internal examination. On internal examination, one of the examinations is weighing post mortem organ weight.[2] It plays an important role as supporting evidence in determining the cause of death, because if there is a difference between the weight of a post mortem organ with the average weight of the post organ mortem is normal, it indicates a change in the organ caused by a pathological state in the organ that is likely related to the cause of the death.[3]

Standard values of post mortem organ weights are needed to determine whether a person's organs are normal or not, such as those found in forensic books and studies that have been conducted in other countries, like South Africa, India, Korea, Thailand, Iran. Research by Vadgama et al. in 2014 in Jamnagar region, India, stated that the standard weight of organs contained in forensic books written by authors from other countries is not appropriate if used in populations in India.[4] It shows that the standard weight of organs using samples in other countries may not necessarily be used as a reference to determine Indonesian organs are normal or not.

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The value of organ weight obtained using samples in other countries may not be appropriate if it is used as a standard for assessing the weight of Indonesian, because between one country and another country has different races and ethnicities and it is known that both of these are some factors that influence weight post mortem organ. These racial and ethnic differences affect organ weight due to differences in the type of food consumed, the amount of water consumed, climatic conditions, and genetic variations in various ethnicities in various countries in the world.[5] In addition to race and ethnicity, there are other factors that may influence weight post mortem organs, namely sex, age, body weight, body length, and body mass index.[3]

Based on that problems that have been described, the author wants to know the average value of post mortem organ weight in autopsy cases that performed at Bhayangkara Pekanbaru Polda Riau Hospital, Indonesia and the average value of post mortem organ weight based on age, gender, and body length.

Method

This research is a retrospective descriptive study using secondary data. This research was conducted in the forensic department of the Bhayangkara Pekanbaru Polda Riau Hospital from August 2018 to May 2019.

The population in this study were all of the autopsy data in the forensic section of Bhayangkara Pekanbaru Polda Riau Hospital in 2017-2018. The sample studied in this study was taken from autopsy data in the forensic section at the Bhayangkara Pekanbaru Polda Riau Hospital in 2017-2018. The sample is part of the population that meets the inclusion and exclusion criteria.

Data was collected from the results of postmortem examinations at Bhayangkara Pekanbaru Polda Riau Hospital in 2017-2018 which were included in the inclusion and exclusion criteria. Data that has been obtained from the data collection process will be changed in the form of tables, then the data is processed using computer software.

Results

Table 1 Characteristics of Research Subjects

	f	%
Gender		
Men	16	76,2%
Women	5	23,8%
Total	21	100%
Age		
21-28 year	7	33,3%
29-36 year	5	23,8%
37-44 year	3	14,3%
45-52 year	2	9,5%
>52 year	4	19,1%
Total	21	100%
Body Length		
142-149 cm	1	4,8%
150-157 cm	3	14,3%
158-165 cm	8	38,1%
166-173 cm	7	33,3%
>173 cm	2	9,5%
Total	21	100%

Based on the characteristics table of the research subjects it is known that there are more men subjects than women subjects, 76.2%. The highest number of cadavers is found in the 21-28 year age group, which is 33.3%. Meanwhile, the highest number of cadavers was found in the 158-165 cm body length group, which was 38.1%.

Tabel 2 Post Mortem Organ Weight (gram)

Organ	**Range**	**Mean**	**Deviation Standard**
Brain	1070-1783	1334,29	161,84
Heart	185-420	275,33	68,17
Right Lung	100-665	370,48	153,18
Left Lung	100-535	311,24	122,95
Liver	858-1670	1130,90	187,24
Spleen	40-421	113,43	90,46
Right Kidney	50-200	114,00	41,97
Left Kidney	40-200	114,52	40,15

Based on table 2, it is known that the brain is an organ that has an average value of the heaviest organ weight (1334.29 grams), while the spleen is the lightest organ (113.43 grams) compared to other organs. Comparison of weight between the same organs with different position, such as the lungs and kidneys shows different results, namely the right lung is heavier (370.48 grams) compared to the left lung (311.24 grams), while the right kidney weight (114.00 grams) lighter than the left kidney weight (114.52 grams).

Tabel 3 Post Mortem Organ Weight (gram) depend on Gender

Organ Weight	Gender					
	Men (n=16)			Women (n=5)		
	Range	Mean	S.D	Range	Mean	S.D
Brain	1070-1783	1350	175,9	1180-1440	1284,0	103,3
Heart	185-420	284,1	66,33	185-350	247,0	73,62
Right Lung	160-665	385,6	152,3	100-500	322,0	162,5
Left Lung	120-535	320,9	127,3	100-400	280,2	155,0
Liver	656-1600	1130,8	180,9	875-1480	1131,0	229,2
Spleen	40-421	120,3	103,0	60-100	91,2	17,5
Right Kidney	50-200	116,5	42,7	60-150	105,8	42,9
Left kidney	40-200	115,6	40,8	60-150	110,8	42,1

The post mortem organ weight table by sex shows that almost all men organs are heavier than women organs, except that the liver in men (1130.8 grams) has an average weight value that is almost equal to the weight of the liver in women (1131.0 grams).

Tabel 4 Post Mortem Organ Weight (gram) depend on Age (year)

Organ	**21-28**	**29-36**	**37-44**	**45-52**	**>52**
	Mean ± S.D	**Mean ± S.D**	**Mean ± S.D**	**Mean ± S.D**	**Mean ± S.D**
Brain	1297,8 ± 84,8	1456,4 ± 214,5	1195,6 ± 192,2	1367,00 ± 188,0	1333,0 ± 120,5
Heart	214,8 ± 31,4	265,2 ± 63,4	292,3 ± 13,0	362,5 ± 17,6	337,5 ± 64.8
Right Lung	342,1 ± 148,8	404,4 ± 179,0	230,0 ± 88,8	497,5 ± 215,6	419,5 ± 105,4
Left Lung	301,2 ± 137,2	388,8 ± 103,2	171,0 ± 67,8	430,0 ± 98,9	277,5 ± 41.7
Liver	1020,2 ± 118,5	1119,8 ± 250,8	1140,6 ± 53,2	1374,0 ± 319,6	1209.5 ± 96.3
Spleen	166,2 ± 126,1	102,8 ± 65,4	54,6 ± 11,5	139,5 ± 85,5	65.2 ± 27.6
Right Kidney	118,4 ± 49,5	100,6± 45,9	90,0 ± .00	155,5 ± 62,9	120.2 ± 24.0
Left Kidney	115,00 ± 45,78	100,60 ± 52,23	113,00 ± .000	135,0 ± 21,21	106.2 ± 48.8

Table 4 show that almost all organs in the 45-52 years age group have an average value of maximum organ weight when compared with other age groups, except the brain (1367.0 grams) and spleen (139.5 grams).

Tabel 5 Post Mortem Organ Weight (gram) depend on Body Length (cm)

Organ	**142-149**	**150-157**	**158-165**	**166-173**	**>173**
	Mean ± S.D	**Mean ± S.D**	**Mean ± S.D**	**Mean ± S.D**	**Mean ± S.D**
Brain	1180	1266,6 ± 57,7	1376,0 ± 144,3	1290,8 ± 122,9	1498,0 ± 403,0
Heart	185	250,0 ± 86,6	297,8 ± 62,0	257,1 ± 67,6	332,0 ± 25,4
Right Lung	210	300,0 ± 173,2	406,8 ± 156,8	352,8 ± 121,5	472,5 ± 272,2
Left Lung	251	250,0 ± 132,2	323,5 ± 116,8	312,4 ± 127,8	380,0 ± 219,2
Liver	875	1100,0 ± 100,0	1258,1 ± 180,8	1041,0 ± 126,9	1111,0 ± 316,7
Spleen	96	100,0 ± .00	87,1 ± 51,5	148,4 ± 138,8	125,0 ± 118,7
Right Kidney	69	120,0 ± 51,9	108,2 ± 42,6	115,7 ± 43,9	144,5 ± 34,6
Left Kidney	74	120,0 ± 51,9	99,5 ± 32,8	120,1 ± 36,4	167,0 ± 45,2

In this study, it was obtained that most organs increased according to a person's height. In the 150-157 cm body length group, brain, heart, right lung, left lung, and liver are lighter than the 158-165 cm body length group. Organs in the body length group > 173 cm are heaviest compared to organs in other body length groups.

Discussion

In this study, the average value of post mortem organ weight obtained from 21 autopsy cases started from the organ with the heaviest to the lightest organ weight, namely the brain (1334.2 grams), liver (1130.9 grams), right lung (370.4 grams), left lung (311.2 grams), heart (275.3 grams), left kidney (114.5 grams), right kidney (114.0 grams), and spleen (113.4 gram). Research conducted by Yosiati et al in 2012 obtained the results of the average weight value of organs, namely the brain (1218.9 grams), heart (312.2 grams), right lung (477.4 grams), left lung (417.0 grams), liver (1252.9 grams), spleen (162.8 grams), right kidney (150.6 grams), and left kidney (151.0 grams). The average value of organ weight obtained from research conducted by Yosiati et al. is not much different from the average weight of organs obtained from this study.[8] The results of this study are also not much different from the research conducted by Govender et al. in the Mongoloid race and the Negroid race. The weight of post mortem organs in the colored skin in Mongoloid race obtained by Govender et al., heart (353.6 grams), right lung (613.0 grams), left lung (486.9 grams), liver (1384.3 grams), spleen (120.8 grams), right kidney (125.0 grams), and left kidney (136.3 grams). Meanwhile, the weight of organs in the Negroid race are the heart (319.7 grams), right lung (571.3 grams), left lung (478.7 grams), liver (1333.5 grams), spleen (145.8 grams) , right kidney (145.0 gram), and left kidney (152.1 gram).[9]

Govender et al. in 2017 conducted research on three different races, namely the Negroid race, the Mongoloid race (colored and Indian skin), and the Caucasoid race showed differences in organ weight in each race. In the research of Govender et al. conducted on the Caucasoid race, there is a very clear difference in the value of organ weight when compared with the value of organ weight in this study which examined the Mongoloid race. The value of organ weight in the study of Govender et al. performed on the Caucasoid race that is the heart (433.4 grams), right lung (753.4 grams), left lung (628.7 grams), liver (1843.8 grams), spleen (233.0 grams), right kidney (164.9 grams), as well as the left kidney (179.3 grams). Based on the results of research by Govender et al. carried out in this Caucasian race, it seems clear that the Caucasoid race has heavier organs than the Mongoloid race.[9] This is due to differences in the type of food consumed, the amount of water consumed, climatic conditions, and genetic variation.[5]

The average weight of post mortem organs by sex in this study differed between men and women. In men, the average weight of post mortem organs were obtained, namely the brain (1350.0 grams), the heart (284.1 grams), the right lung (385.6 grams), the left lung (320.9 grams), the liver (1130.8 grams), spleen (120.3 grams), right kidney (116.5 grams), and left kidney (115.6 grams). Meanwhile, the average weight of post mortem organs in women are the brain (1284.0 grams), heart (247.0 grams), right lung (322.0 grams), left lung (280.2 grams), liver (1131.0 grams), spleen (91.2 grams), right kidney (105.8 grams), and left kidney (110.8 grams). Based on these results, it is known that almost all men organs have an average weight value that is more compared to women, except that the liver in men has a weight that is almost equal to the weight of the liver in women. This is in line with the research of Kim et al. which shows that the liver has almost the same weight in both men and women.[10] Men have organs heavier than women due to the influence of physical posture, ie men tend to be taller and heavier than women. This physical posture affects the weight of the organ.

In the study conducted by Peddle and Kirk in 2017 with Negroid race samples also obtained results that are in line with this study, namely the average value of men organs is heavier than women organs.[3] Similarly, research conducted by Yosiati et al who obtained the result of organ weight in men is heavier than organs in women.[8]

The results of this study are in line with research conducted by Grandmaison et al. in 2000 which showed that men had heavier organs than women. The weight of men organs are heart (365 grams), right lung (663 grams), left lung (583 grams), liver (1677 grams), spleen (156 grams), right kidney (162 grams), and left kidney (160 gram), while the weight of women organs are the heart (312 grams), right lung (546 grams), left lung (467 grams), liver (1475 grams), spleen (140 grams), right kidney (135 grams), and left kidney (136 grams) .[11]

Nonetheless, the average value of post mortem organ weight obtained from this study was very different from

the study conducted by Grandmaison et al., because the average value of organ weight obtained from the study of Grandmaison et al. is heavier than the average value of organ weight in this study. This is likely due to the differences in the sample races studied.

In this study, the weight of the heart organ in the 21-28 year age group was not much different from the weight value of the heart organ in the 21-30 year age group obtained by Deepika et al., but there was a considerable difference in the value of the weight of the heart organ . Deepika et al. obtained 280 grams for heart weight and 1311.03 for liver weight, while this study obtained a weight value of 214.86 for the heart and 1020.29 grams for the liver weight.[5] Meanwhile, the value of organ weight in the age group 37-44 years and 45-52 years in this study were not much different from the weight value of organs obtained from studies conducted by Sheikhazadi et al. in India in 2009.[12]

In this study, it is known that the value of organ weight has increased if the weight of organs in the age group 21-28 years compared with the age group 45-52 years, then experienced a decrease in organ weight in the age group > 52 years. The results of this study are in line with organ weight values contained in Knight's Forensic Pathology, which shows that the weight of organs in the youngest age group is heavier than the oldest age.[13] This is due to the reduced amount of potassium in the aging process. Potassium is a component that plays a role in the body's metabolic function, so it is an indirect indicator of muscle mass. Reduced muscle mass causes reduced organ mass.[14,15]

In addition, almost all of the organs that studied had the heaviest organ weights in the age group of 45-52 years, except for the brains that had the maximum weight in the 29-36 year of age group. The results of this study are in line with the results of research conducted by Singh et al. in 2004. Research Singh et al. states that the brain and liver have a maximum weight in their 20s and 40s compared to other ages, while the lungs and spleen have a maximum weight at 45-50 years of age.[16] Research conducted by Kim et al. also in line with the results of this study, where the weight of the kidneys and liver reaches a maximum weight in their 40s.[10] The heart becomes heavier with age and most organs (spleen, liver, and kidneys) are heavier in individuals in their 40s.[17] After reaching maximum weight, the weight of the organs will decrease due to the aging process which can cause the size of these organs to decrease. In the heart, when middle age, blood pressure will increase, so that the heart's work increases and causes an increase in heart mass.[14] Meanwhile, brain weight tends to increase until adulthood in line with the growth of neurons and glia cells as its supporters, then after through adulthood the brain's weight has decreased.[17]

In this study, it was found that almost the entire weight of the organ increased in accordance with an increase in a person's body length, except in the body length group of 166-173 cm. In the 150-157 cm body length group, the weight of the brain, heart, right lung, left lung and liver organs is lighter than the 158-165 cm body length group. In addition, in this study it appears that all the organs studied have maximum weight in the highest body length group, which is > 173 cm. Based on the results obtained from this study it can be interpreted that people with shorter bodies tend to have lighter organ weights than people with higher bodies. This is because the growth of body organs goes hand in hand with human physical growth.[18] Body proportions will determine the body's metabolism, so the size of the organs must adjust to body proportions.[8]

The results of this study are in line with research conducted by Sheikhazadi et al. in 2009, which found that the weight of organs in both men and women increased with increasing body length. Organs in the body length group 176-192 cm heavier than the body length group 166-175 cm and organs in the body length group 166-175 cm heavier than weight than organs in the body length group 151-165.[12]

Organ weight in this study in each group of body length has a weight value that is very different from research conducted by Grandmaison et al. 2001 in the Caucasoid race. In this study, the organ weight of body length groups of 166-173 cm namely heart (257.1 grams), right lung (352.8 grams), left lung (312.4 grams), liver (1041.0 grams), spleen (148.4 grams), right kidney (115.7 grams), and left kidney (120.1 grams). The weight of organs at body length intervals of 165-175 cm, including the heart (360 grams), right lung (625 grams), left lung (551 grams), liver (1637 grams), spleen (150 grams), right kidney (157 grams) , and the left kidney (175 grams) had very large differences in organ weight and organ weights of 166-173 cm in the length of the body in this study. This very large difference in organ weight values is likely due to differences in race in the sample studied, ie the race studied in this study is the Mongoloid race, while the race in the study of

Grandmaison et al. is a Caucasoid race, because racial differences cause differences in genetic variation. In addition, the Caucasoid race also has a longer body length interval than the Mongoloid race.[11]

Conclusion

Based on research that has been done at Bhayangkara Pekanbaru Polda Riau Hospital, the average value of post mortem organ weight, namely the brain (1334.29 grams), liver (1130.90 grams), right lung (370.48 grams), left lung (311.24 grams), heart (275.33 grams), left kidney (114.52 grams), right kidney (114.00 grams), and spleen (113.43 grams). The organs in men are heavier than in women, except the liver. Organ weight has decreased in old age. People with shorter bodies tend to have lighter organs than taller people.

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References

1. Costache M, Lazaroiu AM, Contolenco A, Costache D, George S, Sajin M, et al. Clinical or postmortem? The importance of the autopsy; a retrospective study. Mædica Journal. 2014;9(3):261.
2. Budiningsih Y, Venita. Autopsi. Dalam: Tanto C, Liwang F, Hanifati S, Pradipta EA (eds). Kapita selekta kedokteran. Edisi IV. Jakarta: Media Aesculapius; 2014. hlm 874–85.
3. Peddle L, Kirk GM. Postmortem organ weights at a South African mortuary. The American Journal of Forensic Medicine and Pathology. 2017;00:1–6.
4. Vadgama DK, Trangadia MM, Mehta RA, Gupta BD. Autopsy study of organ weights in relation to body weight and body length of adult cases in Jamnagar Region. Journal of Indian Academy of Forensic Medicine. 2014;36(3):238–41.
5. Deepika K, Sushma M, Kumar DV. Study of the weights of human heart and liver in relation with age , gender and body height. International Journal of Research in Medical Sciences. 2017;5(8):3469–73.
6. Badan Pusat Statistik. Statistik Kriminal 2017. Vol. 159. 2017.
7. Badan Pusat Statistik. Statistik Kriminal 2018. 2018.
8. Yosiati N, Fitrasanti BI, Syukriani YF. Hubungan antara profil berat organ manusia indonesia dengan usia, jenis kelamin, panjang badan, dan berat badan. Indonesia Journal of Legal and Forensic Sciences. 2012;2(3):54–60.
9. Govender S, Lazarus L, De Gama BZ, Satyapal KS. Post mortem organ weights at a medico-legal state facility in the eThekwini Region. International Journal of Morphology. 2017;35(4):1209–13.
10. Kim Y, Kim D, Cho SY, Kim MH, Yang KM, Lee HY, et al. Statistical analysis for organ weights in Korean adult autopsies. The Korean Journal of Anatomy. 2009;42(4):219–24.
11. Grandmaison GL de la, Clairand I, Durigon M. Organ weight in 684 adult autopsies: new tables for a Caucasoid population. Forensic Science International Journal. 2001;119:149–54.
12. Sheikhazadi A, Sadr SS, Ghadyani MH, Taheri SK, Manouchehri AA, Nazparvar B, et al. Study of the normal internal organ weights in Tehran's population. Journal of Forensic Legal and Medicine. 2010;17(2):78–83.
13. Blaszyk H, Edwards WD, Ludwig J, Waters BL. Normal weight and measurement. In: Waters BL, editor. Handbook of autopsy practice. 4th ed. Totowa, New Jersey: Humana Press; 2009. p. 565–68.
14. He Q, Heshka S, Albu J, Boxt L, Krasnow N, Elia M, et al. Smaller organ mass with greater age, except for heart. Journal of Applied Physiology. 2009;106(0):1780–4.
15. Kehayias J, Fiatarone MA, Zhuang H, Roubenoff R. Total body potassium and body fat : relevance. The American Journal of Clinical Nutrition. 1997;66(0):904–10.
16. Singh D, Bansal Y, Sreenivas M, Pandey A, Tyagi S. Weights of human organs at autopsy in Chandigarh Zone of North-West India. Journal of Indian Academy of Forensic Medicine. 2004;26(3):97–8.
17. Tortora GJ, Derrickson B. Principles of anatomy and physiology. Edisi ke 12. New Jersey: John Wiley and Son, Inc.; 2009. p. 473–688.